Dryland Grain Sorghum In-Furrow Microbiological Product Trials in 2021 & 2022

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Introduction

Plant microbiological products represent a growing part of the agriculture market, and include seed treatments and soil and/or foliar applied products to help improve plant growth. Many of these products contain naturally occurring microbes using endophytes (bacteria or fungi that live inside the plant without causing harm) to help create a symbiotic relationship between the plant and the microbiological product being applied. These products are reported to increase root and plant structures, increase yield, and improve plant nutrient uptake.

A grain sorghum microbiological product trial was conducted at three locations in 2021 and four locations in 2022 in eastern Colorado. The trial consisted of three product treatments plus an untreated control in the first year, and five products plus an untreated control in the second year. Treatments included a mycorrhizal fungal product, multiple bacterial products, and a micronutrient, bacterial, and humic acid blend product. The purpose of the study was to determine if/how the various products affected the grain yield compared to the untreated control. Data collected and summarized included soil test results, field management, grain yield, and grain test weight.

Approach

The trial was planted in farmer or research station fields at Akron, Seibert, and Sheridan Lake, Colorado under dryland production for two years, and Walsh, CO in 2021. Up to five combinations of products were tested on grain sorghum, using commercially available hybrids (DKS28-05 (Akron, Seibert, and Sheridan Lake) and M59GB57 (Walsh) in 2021, and 5C35 (Akron, Seibert, and Sheridan Lake) and M59GB57 (Walsh) in 2022.

In 2021 the treatments were 1) Valent® MycoApply® EndoPrime SC in-furrow applied at 2 fluid oz/ac; 2) PivotBio® ReturN in-furrow applied at 12.8 fluid oz/ac; and 3) Royal-Grow® Enzyme Max® and Ultra Sweet at 16 oz/ac each. There were three total products plus an untreated check tested in 2021. In 2022, treatments one and two (Valent® and PivotBio®) from the year prior were tested again, treatment three (Royal-Grow®) was dropped, and the following treatments were added: 1) Indigo Ag BioTrinsic™ M33 FP and M34 FP products seed applied at 16.2 grams/cwt each; 2) Indigo Ag BioTrinsic™ W10 FP seed applied at 16.2 grams/cwt; and 3) Indigo Ag BioTrinsic™ W12 FP seed applied at 16.2 grams/cwt. There were five total products tested in 2022 along with an untreated check.

The treatments were replicated a minimum of four times in 2021 and a minimum of six times in 2022. Plots were planted in 4-rows that were 10 feet wide by 31 feet long (harvested area). Plots were planted using 30” row spacing, and the sorghum was seeded at a rate of 43,000 seeds/acre. No starter fertilizer was applied but all sites had nitrogen applied pre-plant. Plot seed weight, moisture, and test weight were collected using a Harvest Master H2 grain weighing system on a modified plot combine. Seed yield was adjusted to 14% moisture content. Soil samples were pulled at planting (0-12” and 12-24” depth) and were analyzed at American Agricultural Laboratory, Inc. in McCook, Nebraska. Treatment yield results were analyzed using the mixed model procedure in SAS 9.4. Significant differences were determined

using an alpha level of 0.05, which protects against false positives (concluding treatments are different when they are actually the same).

Results

2021

The average yield across the four sites was 64.9 bu/ac, and test weight was 59 lb/bu. There were no significant differences among the four treatment yields, and no significant difference was found when comparing each of the product treatments to the untreated control within any of the four locations. When data was combined across locations, there was not a location by treatment interaction. Test weight was not significantly different among the treatments or across locations.

2022

The average yield across the three sites was 37.1 bu/ac, and test weight was 57 lb/bu. There were no significant differences among the six treatment yields, and no significant difference was found when comparing each of the product treatments to the untreated control within any of the three locations. When data was combined across locations, there was not a location by treatment interaction. Test weight was not significantly different among the treatments or across locations.

A bar graph for each year comparing each product treatment to the untreated control has been provided. Error bars were added to the graph to help visualize treatment differences (or lack thereof). When the error bars overlap between the two treatments being compared, it indicates that those treatments were not significantly different from one another. Tables for each year with single location yield and yield averaged across sites have also been provided, with the untreated control treatment being repeated to allow direct comparison to each of the product treatments.

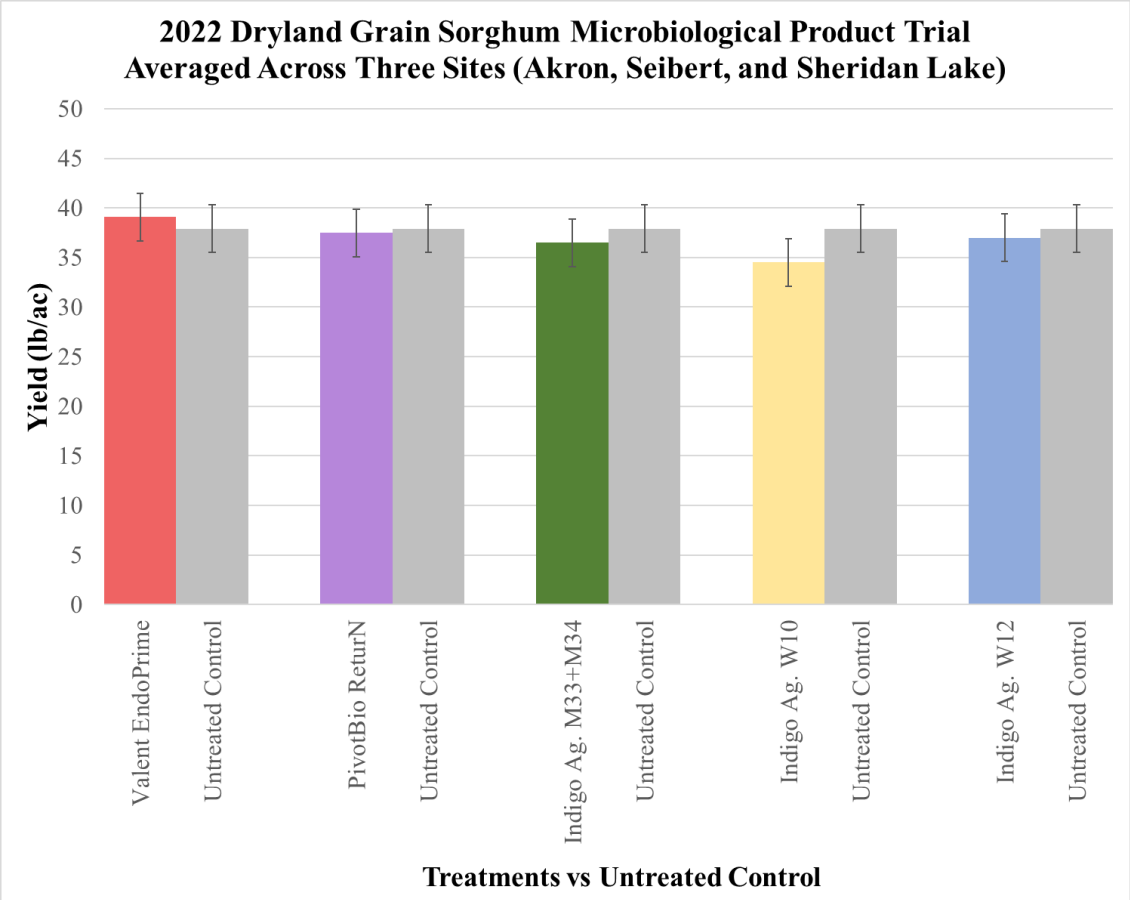
Discussion

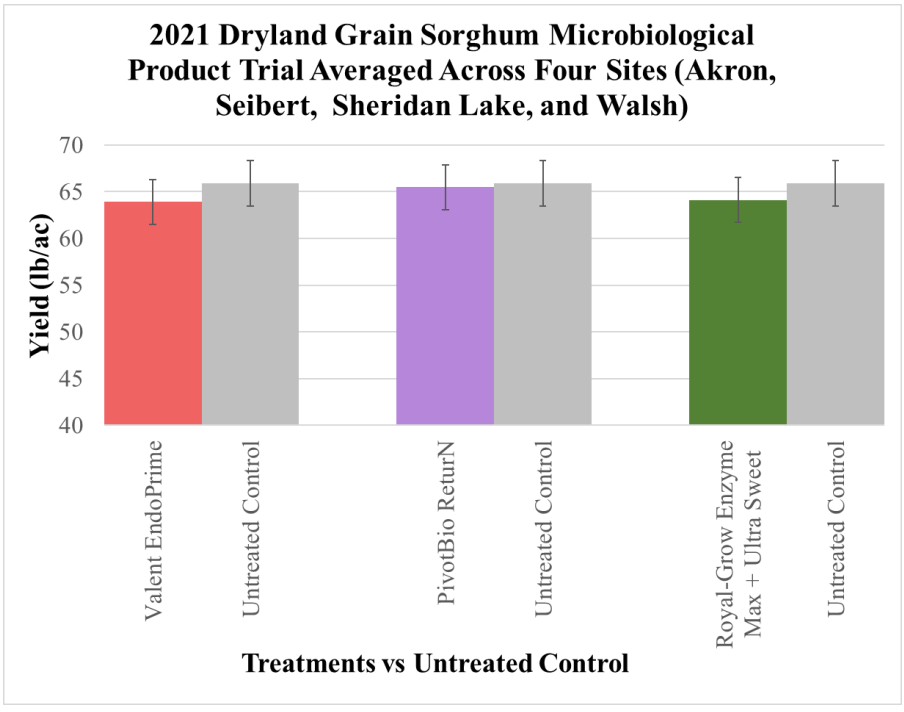
Across the seven site-years, no significant yield increase was observed when sorghum had seed or in-furrow applications of these products. The main benefit/purpose of these products is to increase the plant's ability to obtain important nutrients such as nitrogen and phosphorus, along with water from the soil due to the symbiotic relationship with the bacteria and/or fungi that colonize in the soil and plant roots. Studies have been conducted in both the lab and field and have showed varied plant responses to these products depending on the crop, management practices such as tillage and fertilization, and the general growing environment.

In our study, the amount of available nutrients in the form of nitrogen varied widely among site-years (see tables on following pages). The presence or lack of sufficient nitrogen in the soil did not influence grain yield in our study, possibly due to the more yield-limiting lack of water. In 2022, our grain yield was below 50 bu/ac across all treatments and sites due to drought conditions across eastern Colorado. Grain yield was higher in 2021, ranging from 45 to 76 bu/ac across the sites, but no differences in grain yield, test weight, or visual plant vigor were observed among the treatments.

More research across more environments is needed to parse out potential differences in yield, and in the future we will likely conduct the study under irrigation to see if more plant available water will allow us to detect yield improvements to the plants when these products are applied.

Results Graphs and Tables





COLORADO STATE UNIVERSITY EXTENSION

2022 Dryland Grain Sorghum
Microbiological Product Trial at Three Sites

Crops Testing
www.csucrops.com

Company	Treatments	Avg. Yield	Test Weight	Akron	Seibert	Sheridan Lake
		bu/ac	lb/bu		bu/ac	
None	*Untreated Control*	*37.9*	*56*	*36*	*44*	*34*
Valent Biosciences	EndoPrime SC	39.1	57	37	43	37
None	*Untreated Control*	*37.9*	*56*	*36*	*44*	*34*
Pivot Bio	ReturN	37.5	57	36	45	31
None	*Untreated Control*	*37.9*	*56*	*36*	*44*	*34*
Indigo Ag	W12	37.0	56	34	41	36
None	*Untreated Control*	*37.9*	*56*	*36*	*44*	*34*
Indigo Ag	M33 and M34	36.5	57	35	38	36
None	*Untreated Control*	*37.9*	*56*	*36*	*44*	*34*
Indigo Ag	W10	34.5	56	31	41	31
	Average	**37.1**	**57**	**35**	**42**	**34**
	[b]LSD (0.05)	NS	NS	NS	NS	NS
	Available Nitrate-N (lb/ac top 2 feet):			46	77	73
	Organic Matter Content (%):			1.6	1.3	1.2
	Soil pH in top foot:			6.6	6.8	8.2
	Soil Type:			Keith-Kuma complex	Ascalon sandy loam	Keith-Richfield silt loam

[a]Yields corrected to 14% moisture.

[b]An LSD (alpha 0.05) has been used to minimize the risk of false positive results, or concluding there is a difference when one doesn't exist.

COLORADO STATE UNIVERSITY EXTENSION

2021 Dryland Grain Sorghum
Microbiological Product Trial at Four Sites

Crops Testing
www.csucrops.com

Company	Treatments	Avg. Yield	Test Weight	Akron	Seibert	Sheridan Lake	Walsh
		bu/ac	lb/bu	bu/ac			
None	*Untreated Control*	*65.9*	*59*	*72*	*68*	*73*	*51*
Valent Biosciences	EndoPrime SC	63.9	59	72	65	73	47
None	*Untreated Control*	*65.9*	*59*	*72*	*68*	*73*	*51*
Pivot Bio	ReturN	65.5	59	76	74	67	45
None	*Untreated Control*	*65.9*	*59*	*72*	*68*	*73*	*51*
Royal-Grow	Enzyme Max + Ultra Sweet	64.1	59	67	71	72	46
	Average	**64.9**	**59**	**72**	**69**	**71**	**47**
	[b]LSD (0.05)	NS	NS	NS	NS	NS	NS
	Available Nitrate-N (lb/ac top 2 feet):			56	32	66	124
	Organic Matter Content (%):			1.4	1.1	1.0	1.7
	Soil pH in top foot:			7.3	7.3	8.3	7.7
	Soil Type:			Weld silt loam	Ascalon sandy loam	Olney sandy loam	Richfield silt loam

[a]Yields corrected to 14% moisture.

[b]An LSD (alpha 0.05) has been used to minimize the risk of false positive results, or concluding there is a difference when one doesn't exist.